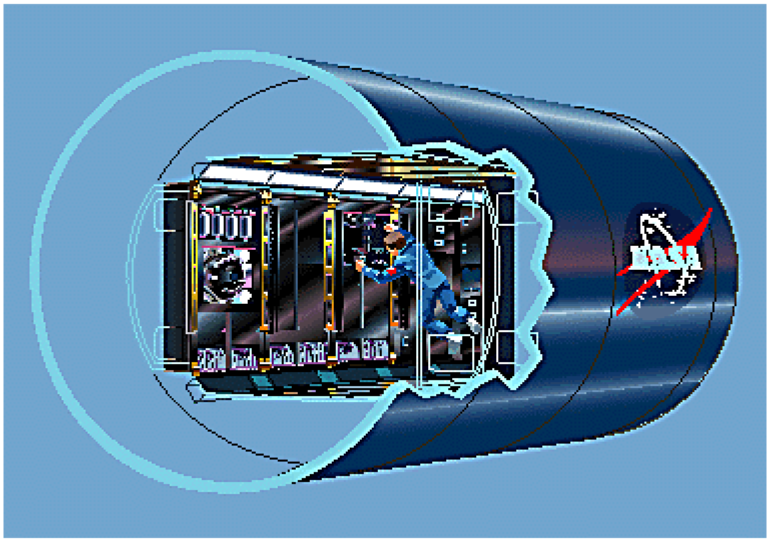
Facilitating Science--The International Space Station Fluids and Combustion Facility



International Space Station Fluids and Combustion Facility.

Scientists in many fields would like to perform experiments on the International Space Station (ISS) to take advantage of the unique environment of microgravity (which is the near-absence of gravity). The ISS will provide the opportunity for scientists to perform microgravity tests over much longer time periods than previously available on the space shuttle--months rather than hours or days--providing more data that could lead to new discoveries. Many of the experiments on ISS will be conducted through the use of new microgravity science facilities. A microgravity science facility is a complete system of on-orbit and ground (on-Earth) hardware, software, operations, and plans that have been optimized to perform sustained microgravity research in one or two scientific disciplines.

The facility concept includes hardware that remains on-orbit (because of its general usefulness) and a small amount of unique hardware that is developed for each principal investigator. Such unique hardware customizes the facility to perform a given principal investigator's experiment effectively. Many facilities are planned for the ISS to accommodate scientists' needs. While the quality and quantity of scientific data are being improved, per-experiment costs will be lowered relative to other ways of performing such experiments.

The NASA Lewis Research Center is developing a Fluids and Combustion Facility (FCF) to perform microgravity fluids and combustion experiments on the ISS. The FCF will be the lowest cost, most resource efficient approach to performing fluid physics and combustion science experiments on the ISS. Experiments performed in the FCF will be 3 to 9 times less expensive than similar Spacelab experiments. Moreover, use of key ISS resources, such as upmass, power, cooling, and astronaut crew time, will be cut by the same factor.

Over its life cycle, FCF experimentation will be no more expensive than that on current low-cost carriers, such as sounding rockets, Get-Away-Special (GAS) canisters, and shuttle middeck lockers. However, it will be far more effective. In spite of its low cost, FCF will be more capable than the most sophisticated and expensive microgravity fluids or combustion hardware yet flown, and these capabilities will be broad and adaptable. Thus, other disciplines (besides fluids and combustion) may also be accommodated.

As the result of FCF concept development, many innovations have been invented at Lewis by a team of Lewis civil servants and contractors from Analex, Aerospace Design & Fabrication, Inc. (ADF), NYMA, Inc., and Sundstrand. The electrical power control units (EPCU) developed are considered "next-generation" in comparison to other power units designed for the ISS. Standardized drawers that house the principal-investor-specific hardware were designed that provide 50 percent more mass-carrying capacity than other ISS packaging concepts; a more rugged construction with greater containment of noise, vibration, electromagnetic interference, and thermal effects; and a reconfiguration setup that does not require any tools and saves astronaut time. Various structures and systems make use of commercial off-the-shelf hardware, saving time and cost. The most advanced video capability of any ISS facility will be available on the FCF; for example, video frame rates from still pictures to as high as 1000 frames/sec. Computers will be designed to allow for evolutionary upgrades to keep the data systems state-of-the-art. Bandwidths to send data back to Earth have been reduced through onboard data processing. A unique four-sided optics bench for fluids experiments was invented that will provide investigators real-time response to experiment data as it occurs, save astronaut time, and save hardware development cost and time. Digital imaging, laser lighting, onboard image analysis and compression, and other imaging innovations to support advanced technology will all be utilized on the FCF. The imaging system will use *Desert Storm* advanced technology to automatically track and zoom-in on moving ìtargetsî of scientific interest, improving resolution and reducing communication bandwidth requirements.

The FCF will provide true telescience to investigators at NASA Centers and remote sites (such as the investigators' universities), and only the future can tell what scientific breakthroughs will result.

For more information, visit the FCF homepage.

Lewis contact: Edward A. Winsa, (216) 433-2861, ewinsa@popserve.grc.nasa.gov
Authors: Edward A. Winsa, Kathleen E. Schubert, and Deborah A. Sedlak
Headquarters program office: OLMSA (MSAD)